The Venomous Snakes of Texas Health Service Region 6/5S:

A Reference to Snake Identification, Field Safety, Basic Safe Capture and Handling Methods and First Aid Measures for Reptile Envenomation

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ABSTRACT: Each year numerous emergency response personnel including animal control officers, police officers, wildlife rehabilitators, public health officers and others either respond to calls involving venomous snakes or are forced to venture into the haunts of these animals in the scope of their regular duties. North America is home to two distinct families of native venomous snakes: Viperidae (rattlesnakes, copperheads and cottonmouths) and Elapidae (coral snakes) and southeastern Texas has indigenous species representing both groups. While some of these snakes are easily identified, some are not and many rank amongst the most feared and misunderstood animals on earth. This article specifically addresses all of the native species of venomous snakes that inhabit Health Service Region 6/5s and is intended to serve as a reference to snake identification, field safety, basic safe capture and handling methods and the currently recommended first aide measures for reptile envenomation.

Native Venomous Reptiles of Texas Health Service Area 6/5s

A) Viperidae

Western Cottonmouth

The western cottonmouth (*A. p. leucostoma*) is medium sized semiaquatic pitviper that is widely distributed throughout eastern and central Texas and is common in all of the counties comprising the 6/5s Health Service Region (Table 1). Cottonmouths will readily enter brackish and salt water and can be found in coastal salt marsh regions, on barrier islands and sometimes on offshore oil rigs.[(1)]

Adult western cottonmouths are typically stout bodied snakes that range from 2 to 4 feet in length with some exceptionally large specimens attaining 5 feet. The dorsal body is patterned with 10 to 15 broad black-edged crossbands with pale centers that often have one or more dark round spots in the central aspect of each (Fig. 1A). The ground color varies from brown to black and often matches the dominant soil in the region of origin. The top and sides of the snout are usually dark brown to black with no visible markings except in juveniles. A dark

longitudinally-oriented cheek stripe is present on each side of the head that effectively masks the eyes. Cottonmouths undergo substantial changes in color and appearance as they mature. The ground color of juvenile western cottonmouths is often much lighter than subadults and adults and they are often so strongly patterned that they are frequently mistaken for copperheads (Fig. 1B) Juvenile cottonmouths and copperheads both often have bright yellow or greenish colored tails that are employed as lures for small frogs and lizards (Fig. 1B). As they grow and mature, cottonmouths undergo ontogenetic cutaneous melanization resulting in anteriograde (tail to head) darkening of the body. In yearling to adult specimens, this phenomenon often causes the dorsal pattern to fade and the background color to darken on the caudal aspect of the body, giving the snake a somewhat characteristic "two-tone" pattern of body coloration (Fig. 1A). With older adults however, the advanced degree of melanization can obscure the dorsal pattern over much of the body, causing some individuals to appear almost entirely black. Some of the other distinguishing features of cottonmouths include; a spade-shaped head bearing large supraocular scales that overhang and effectively conceal the eyes when viewed from above (Fig. 1C).

Other less obvious morphologic features include; a crown of 9 plates on the dorsal head, a "flattened" or "squared off" rostral profile when viewed from above, the presence of bilateral loreal heat-sensing pit organs, elliptical pupils, and the presence of third upper labial scales that extend up to the ventral margins of the eyes. [(1)] The open mouth display (gaping) and the simultaneous vibrating of the tail is part of the cottonmouth's normal defensive behavior (Fig. 1C). The motion of the tail tip during vibration is distinctively slower and somewhat irregular compared to other native pitvipers (rattlesnakes and copperheads) and rat snakes. Learning to recognize their general appearance and coloration peculiarities in conjunction with their behavioral characteristics can be helpful in quickly distinguishing cottonmouths from most non-venomous water snakes in the field.

The cottonmouth is probably the most frequently misidentified snake in North America, largely because it is often confused with the harmless, but often aggressive natricine water snakes that are commonly seen around boat houses, parks and yards on populated lakes. [(2)] Many species of water snakes (*Nerodia* spp.) superficially resemble cottonmouths in body build and coloration and are capable of flattening and widening their head into a triangular, arrowhead-like shape when alarmed (Fig. 1D). Some of the water snake species in region 6/5s that are frequently misidentified as cottonmouths include the diamondback water snake *Nerodia rhombifer rhombifer* (Fig.2A), the broad banded water snake *Nerodia fasciata confluens* (Fig. 2B), the blotched water snake *Nerodia erythrogaster transversa*, the yellow belly water snake *Nerodia erythrogaster flavigaster* (Fig. 2C) and the less common Mississippi green water snake (*Nerodia cyclopion*).[(2)] With practice and learning to focus attention to subtle differences in coloration, morphology and behavior, cottonmouths can be reliably differentiated from non-venomous lookalikes. The sudden change in head shape from a narrow profile to the triangular conformation when alarmed, the medial position of the eyes relative to the lateral margins of the head, the round pupils, pointed snout profile, the vertical striping on the labial scales and failure to gape and vibrate the tail when approached are all features that can be used to differentiate harmless water snakes from cottonmouths (Figs. 1E and 1F).[(3)] When in water, cottonmouths usually swim and rest with the whole body floating buoyantly and head and neck held above the surface whereas water snakes tend to swim with only their head resting on the surface and the remainder of the body at or slightly beneath the water surface (Fig. 1D).[(2)]

Although considered to be one of the most feared venomous snakes in North America, behavioral studies have demonstrated that cottonmouths often rely heavily on threat displays and other defensive (scare) tactics rather than offensive (bite) tactics when challenged or threatened by humans.[(4)] Only when grabbed by the hand and restrained

or stepped on, will cottonmouths regularly employ their fangs and venom defensively.[4] Because of this and their preference for habitats that man typically finds undesirable, cottonmouths usually account for only a small percentage of the venomous bites reported annually that occur in the United States.[5,6]

Fig.1.A.

Fig.1.B.

Fig.1.C

Fig. 1.D

Fig. I.E

Fig. 1.F

Figure 1. Photographs of adult and juvenile western cottonmouths in comparison to a harmless diamondback water snake (*Nerodia rhombifer*). A. Adult western cottonmouth *Agkistrodon p. leucostoma* (Brazoria County, TX) (Photo by W. M. Niederhofer). B Juvenile western cottonmouth (Brazoria County, TX) (Photo by W. M. Niederhofer). C. Adult western cottonmouth *Agkistrodon p. leucostoma* illustrating the defensive open mouth threat display (Brazoria County, TX) (Photo by W. M. Niederhofer). D. Juvenile western cottonmouth illustrating the characteristic elevation of the head and neck when in water (Brazoria County, TX) (Photo by W. M. Niederhofer). E. Head profile of a western cottonmouth when viewed from above (Photo by E. J. Wozniak). F. Head profile of a diamondback water snake (*Nerodia rhombifer*) while in a flattened (defensive) conformation (Photo by E. J. Wozniak). While the head of the alarmed water snake is distinctly triangular, it has a pointed snout in comparison to that of the cottonmouth. In addition to this, most species of water snakes have large protruding eyes with distinctly round pupils that are medial to the lateral margins of the widened head and can therefore be seen from directly above as well as conspicuous vertical striping on the labial scales unlike the cottonmouth.

Fig. 2.A

Fig. 2.B

Fig. 2.C

Fig. 2.D

Figure 2. Some of the common harmless water snake species that are frequently misidentified as cottonmouths. A. Diamondback water snake *Nerodia rhombifer* (Brazoria County, TX) (Photo by E.J. Wozniak), B. Broad-banded water snake (*Nerodia fasciata confluens*) (Anderson County, TX) (Photo by E.J. Wozniak) C. Yellow belly water snake (*Nerodia erythrogaster flavigaster*) (Anderson County, TX) (Photo by E.J. Wozniak). D. Water snakes frequently bask on limbs above water, *Nerodia rhombifer* (Brazoria County, TX) (Photo by E.J. Wozniak). Note the conspicuous vertical striping on the labial scales of all 3 species.

Copperheads

The copperheads (*Agkistrodon contortrix*) are small to medium sized pitvipers that were originally named for the coloration of the dorsal aspect of the head. Five distinct subspecies are recognized, two of which occur in the 6/5s health service region; the southern copperhead (*Agkistrodon contortrix contortrix*), and the broad banded copperhead *Agkistrodon contortrix laticintus*).[(2)] The ground color of all five copperhead subspecies varies from pinkish tan to light orange. The pattern on the dorsal body consists of chestnut to reddish-orange crossbands, the morphology of which varies with the subspecific designation.[(1)] The head is broad and spade-shaped when viewed from above and bears a conspicuous pair of black spots at the posterior margin of the crown (Fig. 3C). Where their ranges overlap, intergradation between copperhead subspecies is common.[(1,2)] Unlike the cottonmouths which typically undergo ontogenetic color change as they mature, juvenile copperheads tend to appear as slightly less colorful replicas of the adults. Copperheads are highly adaptable pitvipers that are capable of surviving in and around human habitations including the wooded suburbs and parks in and around larger cities. [(2)] In contrat to the closely related cottonmouths, copperheads seem to avoid salt water and are seldom found in coastal salt marsh regions or on Gulf Coast barrier islands.[(1,2)] Behaviorally, copperheads are often classified as an “offensive”

species due to their inclination to strike and bite when threatened.[8] Because of their high relative abundance, superb protective coloration and their propensity to bite, copperheads are responsible for a large portion of the snake envenomation cases in the eastern half of North America each year. [5,6] Venom poteny varies somewhat between subspecies but is generally classified as moderately toxic. [5,6,9]

1) Southern copperhead

The southern copperhead (*A. contortrix contortrix*) is a common and well-known pitviper that inhabits the eastern two thirds of the district where it can be found in a variety of habitats including pine and hardwood forests, open fields, river valleys and bottomlands.[1,2] The dorsal body of the southern copperhead is typically tan to light orange and bears a contrasting pattern of 10 to 18 chestnut to brown colored hourglass-shaped crossbands that are sharply angled and markedly constricted at the dorsal midline (Fig 3A). Crossband width at the dorsal apex is typically 3 scale rows or less. [1] Incomplete crossbands, the apices of which fail to meet at the dorsal midline are common in this race, most notably on the caudal half of the body. [1] Southern copperheads can be found in all of Health Service Area 6/5s except western Matagorda and Colorado counties in which broad-banded copperheads or southern/broad-banded copperhead intergrades are the most common forms (Table 1).

2) Broad-banded copperhead

The broad-banded copperhead (*A. contortrix laticinctus)* ranges into the western aspect of the region of concern and is one of the most strikingly colorful members of the copperhead subspecies complex.[1,2] The dorsal body typically bears a pattern of 10 to 17 broad chestnut to reddish-orange crossbands that sharply contrast their light orange to tan ground color (Figs. 3B and 3C). Unlike the southern race, the crossbands of the broad-banded copperhead are nearly as wide at their dorsal apex as they are at the base and extend all the way down onto the ventral scutes.[1] This pattern gives many broad-banded copperheads an alternating coppery red color that is sufficiently different from the better-known southern copperhead to lead to misidentification.[3] Unlike the less habitat-specific southern race, the broad-banded copperhead exhibits a distinct preference for areas with sandy soil that are covered with live oak trees and brush.[1,2] Within such areas, the live oak leaf-covered forest floor and orange colored sandy soil in such areas provides nearly perfect camouflage for the snake's sharply contrasting pattern and coloration. Being one of the two western copperhead races, the distribution of "pure" broad-banded copperheads in Health Service Area 6/5s is limited to the western aspects of Colorado and Matagorda and counties. [1, 2]

Fig. 3.A

Fig. 3.B

Fig. 3.C

Fig. 3.D

Figure 3. Photographs of southern and broad-banded copperheads. A. Adult southern copperhead *Agkistrodon contortrix contortrix* (Montgomery County, TX) (Photo by E. J. Wozniak). B. Subadult broad-banded copperhead *Agkistrodon contortrix laticinctus* (captive bred specimen) (Photo by E. J. Wozniak). C. Adult broad-banded copperhead *Agkistrodon contortrix laticinctus* (origin unknown) (Photo by E. J. Wozniak). D. Head profile of a copperhead showing the general shape, the crown of nine scales that is typical of the genus Agkistrodon and the conspicuous pair of black spots at the posterior margin of the crown that is present on all copperhead subspecies (Photo by E. J. Wozniak).

Rattlesnakes

The rattlesnakes are a well-known group of pitvipers that are unique to the New World and are widely distributed in the State of Texas. Two distinct genera of rattlesnakes are recognized: 1) Crotalus which includes all of the larger varieties and 2) Sistrurus which includes only the massasaugas and pygmy rattlesnakes.[10] Generic classification is largely based upon the morphology of the scales covering the crown of the head. The dorsal crown of *Crotalus* spp. is covered with small scales whereas the crown of *Sistrurus* spp. is covered with nine large plates similar to those observed on copperheads and cottonmouths.[10] Occupying a large portion of the southeastern to south central aspect of the Lone Star State, the 6/5s Health Service Region is home to both genera of rattlesnakes, each of which contains two distinct native species.[10,11] It is important to note that rattlesnakes of any species may or may not rattle a warning prior to a defensive strike. It should also be noted that under damp or flooded conditions, the entry of water into the rattle can effectively silence it and or lead to breakage making the characteristic warning buzz difficult to hear.[3]

1) Western Diamondback Rattlesnake

The western diamondback rattlesnake (*C. atrox*) is a large grey to rust colored serpent that is widely distributed across the southwestern to south-central quadrant of the United States and has a long-standing status as a Texas icon. The dorsum of the typical *C. atrox* bears a series of dark rhomb-shaped markings that are bordered by concentric rows of sharply contrasting dark and light cream to white colored scales (Fig. 4A). The dorsal pattern is most prominent on the anterior half of the body and fades into a series of less conspicuous crossbands caudally (Fig. 4A). The tail of this species is conspicuously marked with a series of sharply contrasting black and white rings of roughly equivalent width, a feature that has earned the species the local name "coon tailed rattlesnake" in some localities.[2] The head of the western diamondback bears a dark gray mask bordered by prominent white lines that runs diagonally across the cheeks, effectively concealing the eyes (Fig. 4A). Unlike any other rattlesnake in its range, the caudal white lines of the mask run down to, rather than behind the corners of the mouth.[2] Despite it being frequently thought of as a desert species, the western diamondback thrives in a variety of habitats including desert, prairie, thorn forest, woodlands and coastal sand dune areas [2] Crotalus *atrox* is an abundant species along approximately 80 % of the Texas Gulf Coast and its barrier islands from Galveston Island southwestward to and beyond the level of Brownsville.[2] Within Health Service Area 6/5s, the western diamondback has been documented in Matagorda, Galveston, Brazoria, Harris and Fort Bend counties (Table 1).

The western diamondback is characterized as a highly excitable and aggressive rattlesnake species that is responsible for a significant number of the snake envenomations in the United States each year and is capable of delivering a fatal bite.[10,12] The venom of this species is a complex mixture tissue destructive enzymes, hemotoxins and some neurotoxic peptides. Pain, swelling, hemorrhage, local necrosis, lymphadenopathy, coagulopathy, dizziness, fainting, and hypovolemic shock is commonly reported with bites by this species.[2] Long term peripheral morbidity including permanent disfigurement and the loss of digits or limbs are common sequelae.[2,12]

2) Timber rattlesnake

The timber rattlesnake (*Crotalus horridus*) is a large, heavy bodied, banded rattlesnake that ranges throughout a large portion of eastern and central North America and has remained an American icon since its illustration on the yellow Gadsden flag along with the infamous words "Don't Tread on Me". The ground color of this species varies somewhat across its geographic range but is generally yellow to tan with variable amounts of black stippling.[2] The dorsal pattern is best characterized as a series of black chevrons and the caudal body and tail are almost invariably black, a feature which gives the species the local name "velvet tailed rattler" in some localities (Fig. 4B). Individuals originating from the southern and western aspects of the snake's range including Texas, typically have a prominent cinnamon colored vertebral stripe that extends from the neck down to the level of the tail a pair of black stripes on the head that extend from the eyes caudoventrally to and beyond the corners of the mouth.[2]

The timber rattlesnake inhabits a variety of habitats including but not limited to upland deciduous forests, rocky ridges, riparian corridors, cypress swamps, cane reed thickets and wet prairie regions.[2] Once an abundant species, timber rattlesnakes are declining at an alarming rate in many areas. Within the State of Texas the timber rattlesnake is classified as a threatened species and is protected by law.[2,11] Within Health Service Area 5/6s, the western diamondback has been documented in Matagorda, Galveston, Brazoria, Harris and Fort Bend counties (Table 1).

Crotalus horridus is a large rattlesnake species that produces moderate to large amounts of potent venom. Venom potency is reported to vary considerably between populations and even different individuals within a given

population can yield markedly different LD_{50} values.[2] Certain populations of this species have been shown to produce deadly neurotoxic peptides.[2] Interestingly, both of the snakebite fatalities reported to the American Association of Poison Control Centers (AAPCC) in 2002 were attributable to bites by *C. horridus*.[3]

3) Western pygmy rattlesnake

The western pygmy rattlesnake (*Sistrurus miliaris streckeri*) is a small pinkish-colored rattlesnake that ranges throughout most of Mississippi, Arkansas and Louisiana, eastern Texas and southeastern Oklahoma.[2] The ground color of this species is typically light pink to tan and the dorsum is marked with rust colored longitudinal stripe and a series of contrasting black blotches that are often laterally extended into transversely oriented bar-like spots (Fig. 4C). The sides of the body bear double rows of black spots that sometimes extend onto the pale belly. The head is boldly marked with black stripes on both the crown and the sides, the later of which effectively forms a mask that effectively conceals the eyes.[2] Like other members of the pygmy rattlesnake species complex, the rattle of the western pygmy rattlesnake is tiny and inconspicuous compared to those of other Texas rattlesnakes and is at best audible from only a few feet away (Fig. 4C). The western pygmy inhabits a variety of different habitats in eastern Texas including long needle pine and pine-oak and river bottom hardwood forests, palmetto scrub lowlands and wet saw grass prairies.[2] Although it is a wide ranging species, *S. miliaris streckeri* is very spottily distributed over its range and is a rather uncommon snake in many areas within the State of Texas.[2,11] Because of this, it preference for areas with abundant ground cover and its rather secretive nature, the western pygmy rattlesnake is seldom encountered in the wild.[2] The venom of this species is characterized as moderately potent but due to the snakes small size, is produced in small quantities in comparison to the other native pitviper species.[2,5,10]

4) Western Massasauga

The western massasauga (*S. c. tergeminus*) is a small to medium blotched rattlesnake that ranges throughout a large portion of the southwestern prairie region of the United States. Being primarily a grassland dwelling species, the western massasauga exists in the isolated vestiges of tall-grass prairie that remain in the 200 mile wide strip that extends diagonally from the northern Gulf to the northeastern Texas Panhandle. Within Health Service Region 6/5s, the range of the western massasauga is limited to Galveston, Chambers Matagorda, and Colorado counties. Throughout their range, massasaugas tend to occur in small localized populations that are vulnerable to development and agricultural practices.[2] At least in part because of this, massasaugas are classified as being uncommon in the State of Texas.

The ground color of this small to medium sized rattlesnake is typically gray to tan and the dorsum typically bears a series of round to irregularly shaped dark blotches (Fig. 4D). The sides of the head are marked with a dark, white edged mask that runs diagonally across the cheeks, extending from the crown, across the eyes to an area just posterior to the corners of the mouth. Although small in comparison to members of the genus Crotalus, massasaugas usually have much larger and more conspicuous rattles than the pygmy rattlesnakes. Despite their small size and comparatively short fangs, the venom of the massasauga is characterized as being moderately potent and is capable of causing significant local tissue damage.[5]

Fig. 4.A

Fig. 4. B

Fig. 4.C

Fig. 4.D

Figure 4. Rattlesnake species native to Texas Health Service Area 5/6s. A. Western diamondback rattlesnake *Crotalus atrox.* (Crockett County, TX) (Photo by E. J. Wozniak). Note the diamond-shaped pattern on the anterior body and contrasting black and white rings on the tail that typify the species. B. Timber rattlesnake *Crotalus horridus* (captive born specimen) (Photo by E. J. Wozniak). C. Western pygmy rattlesnake *Sistrurus m. streckeri* (Anderson Conty, TX) (Photo by E.J. Wozniak). D. Western massasauga *Sistrurus c. tergeminus* (South Texas Herp Society live collection) (Photo by E. J. Wozniak).

B) Elapidae

Texas coral snake

Coral snakes are small brightly colored members of the family Elapidae and represent the only members of this family that are native to North America. The Texas Coral snake *Micrurus tener tener* is the only species native to the State of Texas and has the characteristic pattern of wide red and black rings separated by thinner yellow rings and can therefore be readily distinguished from the similarly-colored harmless king, milk and scarlet snakes by the infamous rhyme, “red on yellow kill a fellow.” (Figs. 5Aand 5B).

Coral snakes are secretive and generally inoffensive animals that are largely fossorial and seldom seen, even in areas that harbor dense populations. [(2)] In contrast to the vipers, the fangs of the coral snakes and other elapids are short hollow structures that are permanently fixed in position on the anterior maxillary bones. [(13)] Because of their small size and short fangs, the North American coral snakes pose little risk to individuals wearing appropriate clothing and footwear. Most of the bites in humans occur on the hands and usually involve a coral snake that was intentionally picked up and handled. [(14)]

Fig. 5.A

Fig. 5.B

Figure 5. A Texas coral snake and a harmless mimic. A. Texas coral snake *Micrurus tener tener*. (Brazoria County, TX) (Photo by W. M. Niederhofer). B. The harmless Mexican milk snake *Lampropeltis triangulum annulata* (captive born specimen (Photo by E.J. Wozniak). Note the difference in the sequence of colored bands between these two species. The Louisiana milk snake *Lampropeltis triangulum amaura* which ranges throughout the area is very similar to the Mexican milk snake in appearance except for the presence of conspicuous white mottling on the anterior snout.

Table 1. The Distribution of Native Venomous Snakes in Texas Health Service Region 6/5S.

County	Western Cottonmouth	Southern Copperhead	Broad Banded Copperhead	Western Pygmy Rattlesnake	Western Massasauga	Western Diamondback Rattlesnake	Timber Rattlesnake	Texas Coral Snake
Matagorda	X	X		X	X	X		X
Wharton	X	X	X	X			X	X
Colorado	X	X	X		X		X	X
Austin	X	X	X				X	X
Waller	?	X						X
Walker	X	X					X	X
Ft Bend	X	X				X	X	X
Brazoria	X	X		X		X	X	X
Galveston	X	X		X	X	X		X
Harris	X	X		X		X	X	X
Montgomery	X	X		X				X
Liberty	X	X		X			X	X
Chambers	X	X		X	X		X	X
Jefferson	X	X		X			X	X
Orange	X	X		X				X
Hardin	X	X		X				X

Note: This table represents an approximated summation of data from several field guides and distribution maps (1, 2, 7, 11, and 23) and the experience of the authors at different time points. Animal distributions change over time for a variety of factors most notably with urban and agricultural development. Because of this, distribution maps and tables are at best an approximation of the actual distribution of a given species.

Bite Victim First Aid

A) Pitviper bites

The current recommendations for pit viper envenomation are to place the victim at rest and keep calm and warm. [5, 12] The injured part of the body should be immediately freed of any constricting jewelry, immobilized with a loose fitting dressing and if possible, maintained at the level of the heart.[12]. Paramedical attention should be directed towards the maintenance of a patent airway, administration of oxygen, establishment of intravenous access in an unaffected limb, and prompt transportation to the nearest medical facility. [12]. Immediate hypersensitivity reactions to venom are possible in some cases and may require epinephrine and antihistamines.[5,12] The progression of swelling should be closely monitored during transport. Marking the advancing edge of the swelling with a marker at 15 to 20 minute intervals can provide the treating physician with valuable information on gauging the severity of the bite [3, 12] The dated "cut and suck" method recommended in the 1960's and 70's, the use of venom extraction devices, chill methods, electroshock therapy and tourniquets have all been shown to have the potential to worsen the outcome of a bite and are now strongly discouraged.[12]

Once at a medical facility, victims of snake bite should be promptly evaluated by a qualified physician.. Aggressive supportive care including pain management, wound management including updating tetanus prophylaxis and anti-venom therapy are often required for effective treatment.[12] The only FDA-approved antivenom for North American crotalid bites that is currently being manufactured is CroFab (Protherics – Atlanta division of Savage Laboratories, Brentwood, TN). Consultation with a medical toxicologist at a regional poison control center (National Hotline (800) 222-1222) is recommended for the treatment of any pit viper envenomation cases.

B) Coral snake bites

Because of their short fangs and venom that is primarily a systemic neurotoxin, the triage and treatment of victims bitten by coral snakes (*Micrurus* spp.) is quite different from that recommended for pitvipers. Studies on elapid snakebites involving Australian species have shown that pressure immobilization bandaging of the affected limb can effectively impede the egress of toxins from the bite site and delay systemic involvement.[15,16] The recommended methods are to start the wrap at the bite site and cover the entire extremity which is subsequently immobilized with a splint or sling. The goal in applying the wrap is to impede lymphatic flow by attaining pressures of 40 to 70 mm Hg in upper extremities and 55 to 70 mm Hg on the lower limbs.[17] Experimental studies have documented that attaining the desired pressures is technically difficult and suggest that effective use of this method may require extensive training and experience.[17] Because of this, properly training emergency response personnel on the application of pressure immobilization bandages is recommended in areas were elapid snakes are common. Experimental evidence indicates this method to be highly effective with coral snake bites.[18]

All coral snake bite victims should be transported to the nearest medical treatment facility as soon as possible. [12,14] Case studies have demonstrated that the onset of neurological signs and symptoms of envenomation can be delayed for as long as 12 hrs.[14] Because of this, all suspected coral snake bite victims should be admitted and closely monitored for signs of neurotoxicity, oxygen saturation and ventilatory function for a minimum of 12 hrs. [12] Consultation with a regional poison control center (National Hotline (800) 222-1222) is recommended. The only

FDA approved antivenom product available for the treatment of American coral snake bites is Wyeth anti-*Micrurus fulvius* antivenin (Wyeth-Ayerst, Marietta, PA). The formerly described anti-pitviper venom product (Cro-Fab), is not effective against *Micrurus* spp.venoms and is not indicated in coral snake bite cases.

Snake bite prevention

There are a number of things that emergency response personnel can do to prevent snake related accidents. First off, potential responders should familiarize themselves with all of the indigenous species, their habits and their medical significance. When traversing of working in snake inhabited areas, personnel should avoid putting their hands and feet in places that can not be visually inspected for snakes. The safest way to cross obstacles such as fallen trees or other large pieces of debris is to step up onto the structure, check for snakes on the opposite side and then carefully stepping into the visually cleared area. When traversing flooded areas, great care should be taken to avoid blind contact with brush or limbs projecting over or out of the water. Snakes displaced by high water will often climb onto such structures and may be concealed by foliage.[3,19] Appropriate protective clothing should be worn at all times when venturing into areas likely to harbor venomous snakes. Minimally this should include; loose fitting trousers, long-sleeved shirts and boots.[19] For added protection against the entry of snakes and/or arthropods into pant legs, the trousers should be bloused. Wearing clothing in this manner confers several protective features to the individual including; affording mechanical protection against bites, limiting the heat signature of the body, diverting fangs away from the skin and limiting the depth of fang penetration if bitten.[19]

In the event that a venomous or unidentified snake is encountered in the field, it is best to slowly move out of the snakes strike range without making any sudden or erratic strike-provoking movements. As a general rule of thumb, the maximal strike distance of most snakes is approximately one half of their body length so attaining a distance of approximately one body length is sufficient to confer safety.

Conservational concerns

Recent studies have documented reptile venoms to very complex mixtures of proteins that are rich sources of unique peptides and other potentially valuable biomolecules that can be isolated and employed in the treatment chronic human diseases such as diabetes, cancer and heart disease.[3,20,21,22] In addition to being a potential source of valuable pharmaceuticals, snakes are highly efficient predators of pestiferous rodent species and play a vital role in their control. Because of these and other reasons, snakes encountered in their native habitat should be treated with respect and left alone.

With the ongoing expansion of urban development, encounters with displaced wildlife are on the increase including those involving venomous snakes. The needless killing of snakes and other animals should be discouraged under any conditions. Many places now recommend the safe capture and relocation of snakes to decrease unnecessary destruction of all indigenous wildlife including snakes. To meet these new expectations, animal control officers and other personnel responding to calls for venomous snakes should become proficient with safe reptile capture and handling methods.

Safe capture and handling methods

In any situation involving a snake, venomous or not, awareness of your surroundings is of the utmost importance. Snakes can and will take advantage of any "hide spot" available, to include the smallest and tightest of places. Once the snake is located use a pair of snake tongs to capture it or maneuver it to an area away from potential escape points and then capture it. It should be noted that for animal control officers and first responders, unless you can make a positive identification of the snake, treat it as a venomous animal.

Figure 6. Illustration of a safe capture method for venomous snakes. The snake is picked up mid body so it is somewhat balanced and is gently placed in a container (Photo by E.J. Wozniak). With the snake safely on the floor of the container, the lid should be lowered and secured in place. Venomous or unidentified should be gently picked up with snake tongs and placed individually in bite proof containers that have a secure lid. Having a central handle on the lid protects the handler in the event of an upward strike. Five-gallon plastic buckets provided with air hole for ventilation and a centrally mounted handle in the lid work well for most applications. In the experience of the authors, the keys to safe handling venomous snakes are to adopt a hands-off approach, to always maintain a safe working distance, knowing your limitations, always exercising your best professional judgment and being ready for the unexpected.

The first and foremost tool an animal control officer or first responder needs to have is knowledge of what species of snakes are prevalent in his or her particular area. With the ability to correctly identify the snake, the physical tools needed are quite simple, a pair of snake tongs and a bucket with a secure lid that has a handle on it (Fig. 6). Using the tongs, gently, but securely grasp the snake in the first one third of its body, not the head, lift it and place it in the bucket and secure the lid. Once the snake is safely contained, the collector should make sure to clearly mark the bucket with the words "VENOMOUS SNAKE" to warn any unsuspecting people of its contents. After capture, the disposition of the snake will be determined by your department's standard operating procedures.

Literature Cited

1. Gloyd HK, Conant R. *Snakes of the Agkistrodon Complex: A Monograph Review*. Oxford, OH: Society for the Study of Amphibians and Reptiles; 1990.

2. Tennant A. *A field Guide to Texas Snakes* 2nd ed. Houston, TX: Gulf Publishing Company; 1997.

3. Wozniak, E.J., J. Wisser and M. Schwartz. 2006. Venomous Adversaries: A Reference to Snake Identification, Basic Field Safety and Bite Victim First Aide for Disaster Response Personnel Deploying into the Hurricane Prone Regions of North America. *Wilderness Environ Med* 2006; 17(4): 246-266.

4. Gibbons W, and Dorcas M. Defensive behavior of cottonmouths (*Agkistrodon piscivorus*) toward humans. *Copeia* 2002(1):195-198.

5. Russell, F.E. 1983. *Snake venom poisoning*. Great Neck, NY: Scholium International Inc., 1983.

6. Lawrence WT, Giannopoulos A, Hansen A. Pitviper bites: Rational management in locales in which copperheads and cottonmouths predominate. *Ann Plast Surg* 1996; 36:276-285.

7. Tennant A. *A Field Guide to Snakes of Florida.* Houston, TX: Gulf Publishing Company; 1997

8. Gibbons W and Dorcas M. *Snakes of the Southeast.* Athens, GA: University of Georgia Press; 2005

9. Scharman EJ, Noffsinger VD. Copperhead snakebites: clinical severity of local effects. *Ann Emerg Med* 2001; 38(1):55-61.

10. Klauber, LM. *Rattlesnakes: Their Habits, Life Histories, and Influence on Mankind* 2nd ed. Los Angeles, CA: University of California Press; 1997.

11. Price AH. *Poisonous Snakes of Texas*, Austin. TX: University of Texas Press; 1998.

12. Gold BS, Dart RC, Barish BA. 2002. Bites of venomous snakes. *New Engl J Med* 2002; 347:347-356

13. Porter KR. *Herpetology*. Philadelphia, PA: W.B. Saunders Company; 1972

14. Kitchens CS, Van Mierop LH. Envenomation by the Eastern coral snake (*Micrurus fulvius fulvius*). A study of 39 victims. *JAMA* 1987; 258(12):1615-1618.

15. Sutherland SK, Coulter AR, Harris RD. Rationalization of first-aid measures for elapid snakebite. *Lancet* 1979; 1:183-186.

16. Murrell G. The effectiveness of the pressure/immobilization first aid technique in the case of a tiger snake bite. *Med J Aust* 1981; 2(6):295.

17. Norris RL, Ngo J, Nolan K, Hooker G. Physicians and lay people are unable to apply pressure immobilization properly in a simulated snakebite scenario. *Wilderness Environ Med* 2005; 16(1):16-21.

18. German BT, Hack JB, Brewer K, Meggs WJ. Pressure-immobilization bandages delay toxicity in a porcine model of eastern coral snake (*Micrurus fulvius fulvius*) envenomation. *Ann Emerg Med* 2005; 45(6):603-608.

19. Murdock RT, White GL Jr, Pedersen DM, DeFaller JM, Snyder CC. Prevention and emergency field management of venomous snakebites during military exercises. *Mil Med* 1990; 155(12):587-90

20. Zhou Q, Sherman SP, Parrish C et al. Contortrostatin, a dimeric disintegrin from Agkistrodon contortrix contortrix inhibits breast cancer progression. *Breast Cancer Res Treat* 2000; 61:249-260.

21. Hong SY, Koh YS, Chung KH, Kim DS. Snake venom disintegrin, saxatilin, inhibits platelet aggregation, human umbilical vein endothelial cell proliferation and smooth muscle cell migration. *Thromb Res* 2002; 105:79-86.

22. Iwamoto H, Sakai H, Kotoh K, Nakamuta M, Nawata H. Soluble Arg-Gly-Asp peptides reduce collagen accumulation in cultured rat hepatic stellate cells. *Dig Dis Sci* 199; 44(5):1038-1045.

23. Herps of Texas. Available at www. zo.utexas.edu